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ABSTRACT

This paper develops the thesis that the knowledge a person possesses has a potent influence on what he or she will learn and remember from exposure to discourse. After outlining some assumptions about the characteristics of the structures (schemata) in which existing knowledge is packaged, a theory of the processes involved in assimilating the information and ideas in discourse is developed. Data consistent with the theory are summarized from a variety of experiments. Educational implications of schema theory are also discussed. (AA)

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SCHEMA-DIRECTED PROCESSES IN LANGUAGE COMPREHENSION

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Schema-Directed Processes in Language Comprehension

In this paper I will develop the thesis that the knowledge a person already possesses has a potent influence on what he or she will learn and remember from exposure to discourse. I will begin by outlining some assumptions about the characteristics of the structures in which existing knowledge is packaged. Next, based on these assumptions, I will present a speculative theoretical treatment of the processes involved in assimilating the information and ideas in discourse. This is the topic that will be given most attention in this paper. Data consistent with the theory will be summarized. It should be emphasized in advance, however, that our experiments to date show at most that the theoretical notions are interesting and plausible. The research has not advanced to the point where we have a firm basis for choosing between competing accounts. Finally, I will make some observations about the implications of this research for education.

Schematic Knowledge Structures

Like many others (Ausuble, 1963; Minsky, 1975; Schank & Abelson, 1975; Bower, 1976; Rumelhart & Ortony, 1977), I find it useful to postulate that knowledge is incorporated in abstract structures that have certain properties. These structures will be called schemata in deference to Piaget (1926) and Bartlett (1932), who introduced the term to psychology. What follows is an amalgam of my own thinking and that of other theorists.

A schema represents generic knowledge; that is, it represents what is believed to be generally true of a class of things, events, or situations.

A schema is conceived to contain a slot or placeholder for each component. For instance, a Face schema (Palmer, 1975) includes slots for a mouth, nose, eyes, and ears. Encoding a particular object is conceived to be a matter of filling the slots in the schema with the features of the object. Part of schematic knowledge is the specification of the constraints on what normally can fill the slots. An object will be recognized as a face only if it has features that qualify as eyes, a mouth, a nose, and so on. To be sure, the constraints on the slots in a Face schema are flexible enough that we can tolerate considerable variation, as in a sketchy drawing in a comic strip, the stylized and transformed representation in a cubist painting or the exaggerated portrayal in a political cartoon (Gombrich, 1972). Nonetheless, there are limits beyond which an object is no longer a face.

The encoded representation of a particular thing or event consists of a copy of the schemata which were brought to bear in interpretation plus the information inserted in the schemata's slots. Such particularized representations are called instantiated schemata (cf. Anderson, Pichert, Goetz, Schallert, Stevens, & Trollip, 1976). The slots in a schema may be instantiated with information that could be said to be "given" in the situation, or message, but often slots are filled by inference.

A schema is a knowledge "structure" because it indicates the typical relations among its components. A Face schema will represent the relative spatial positioning of the eyes and nose, for instance. Another attribute of schemata with structural significance is that they exist at various levels of abstraction and embed one within another (Rumelhart & Ortony,

1977). Contrast the knowledge that (1) a face has eyes, (2) an eye has a pupil, (3) a pupil dialates in the dark. It is apparent that these propositions are arranged in decreasing order of importance to faces. This variation in importance can be captured by assuming that Eye is a subschema embedded in the Face schema; and that Pupil, in turn, is a subschema of Eye. It is assumed that a person can employ a dominant schema without necessarily accessing the knowledge available in embedded subschemata. On the other hand, should the occasion demand it, the full meaning of a subschema can be unpacked and a deeper interpretation given.

To comprehend a message is to place a construction upon it which gives a coherent formulation of its contents. In schema terms, a "coherent formulation" means a one-to-one correspondence between the slots in a schema and the "givens" in the message. It is instructive to examine the comprehension of a sentence devised by Bransford and McCarrell (1974) for which a subsuming schema is not readily apparent: The notes were sour because the seams split. The syntax is simple and the individual words are easy, yet the sentence as a whole does not immediately make sense to most people. However, the sentence becomes meaningful as soon as one hears the clue bagpipe. Why is this clue effective? An answer is that it enables the conception of a framework which maps onto a possible world. Within the framework each word in the sentence can be construed to have a referent with a sensible role to play in the possible world. That is to say, the clue allows one to invoke a schema containing slots for the objects, actions, and qualities mentioned in the sentence. The schema gives a good account of the sentence and, therefore, there is the subjective sense that it has been comprehended.

Conceptions of the Reading Process

According to one view, reading is a "bottom-up" or "data-driven" process (Bobrow & Norman, 1975). There is a series of discrete processing stages each corresponding to a level of linguistic analysis. Analysis proceeds from the most primitive low-order level to the most complex high-order level. As a first step, feature analyzers are brought to bear to discriminate horizontal, vertical, and oblique line segments; open and closed loops; intersection with a horizontal plane; and so on. From these, letters are identified. Strings of letters are analyzed into clusters with morphophonemic significance. Words are recognized. Strings of words are parsed into phrase constituents. Word meanings are retrieved from the subjective lexicon. Eventually a semantic interpretation of a sentence is produced. Sentence meaning is conceived to be the deterministic product of the lower-order levels of analysis and, presumably, the meaning of a text is a concantenation of the meanings of its component sentences.

Another view holds that reading is essentially a "top-down" or "conceptually driven" process. Rather than analyzing a text squiggle by squiggle, the reader samples it to confirm or reject hypotheses about its content. In other words, reading is conceived to be a psycholinguistic guessing game (Goodman, 1967). The reader's expectations represent a form of preprocessing which should expedite and speed up subsequent analysis. Occasionally expectation would be predicted to override the print, as appears to happen when children make miscues in oral reading, substituting semantically related words in place of those given.

There is an interesting difference between the bottom-up and top-down theories about reading in their treatment of ambiguity. According to the former view a high-order process does not affect low-order processes. Each stage takes as its input the output from the preceding stage. If an ambiguity arises at any stage, the alternative interpretations are sent forward for resolution at a later point. For instance, it would be supposed that all of the meanings of a homonym are accessed. Eventually, if the message as a whole is not ambiguous, a process operating on syntax, semantics, or pragmatics at the phrase, sentence, or text level, will permit a choice among the homonym's senses.

From the perspective of a bottom-up model, reading is a matter of growing a tree of possible interpretations. Any stage may add new branches, or prune some of those already there. From the perspective of a model that admits of possible top-down influences, on the other hand, not all of the branches need be grafted on to the tree in the first place. Emerging high-order expectations may forstall some interpretations before they occur. With respect to the meaning of a homonym, it might be expected that normally only the contextually most appropriate meaning would be accessed. This is the implication of research by Schvaneveldt, Meyer, and Becker (1974) using a lexical decision task. For instance, money was identified as a word faster in the sequence save, bank, money than in either river, bank, money, or the control sequences save, date, money or fig, date, money. If all senses of a word were activated, bank should have primed money to some extent even when preceded by river, but this did not happen. Converging evidence has been obtained by Swinney and Hakes (1976) who found,

using a phoneme monitoring task, that a disambiguating context of a sentence or two can constrain the interpretation of a subsequently encountered homonym.

Of course, it is surely simplistic to imagine that reading is either a bottom-up or a top-down process. Rumelhart (1976) has presented a persuasive case that reading must involve continuous interactions among many levels of analysis. I am dealing in this paper with how concepts brought to a text influence comprehension, learning, and recall but, to assert the obvious, the processes involved in analyzing the print itself are also crucial.

Schemata and Text Interpretation

We have used several tricks to get people to bring different schemata into play when reading text. Several studies have employed whole passages which were ambiguous. For instance, Schallert (1976) constructed passages that could be given two distinct interpretations. One of the passages told of a character who was afraid that his best pitchers would crack in the heat. The passage was entitled "Worries of a baseball manager" or "Worries of a glassware factory manager." Scores on a multiple-choice test--constructed so that the interpretation of pitcher and other similarly ambiguous elements could be distinguished--indicated that the interpretation of this and other passages was strongly related to the title.

In the absence of strong contextual cues, such as titles and introductions, the schemata by which people assimilate ambiguous passages can be expected to depend upon their background and life situation. Anderson, Reynolds, Schallert, and Goetz (1977) wrote the following passage:

> Every Saturday night, four good friends get together. When Jerry, Mike, and Pat arrived, Karen was sitting in her living room writing some notes. She quickly gathered the cards and stood up to greet her friends at the door. They followed her into the living room but as usual they couldn't agree on exactly what to play. Jerry eventually took a stand and set things up. Finally, they began to play. Karen's recorder filled the room with soft and pleasant music. Early in the evening, Mike noticed Pat's hand and the many diamonds. As the night progressed the tempo of play increased. Finally, a lull in the activities occurred. Taking advantage of this, Jerry pondered the arrangement in front of him. Mike interrupted Jerry's reverie and said, "Let's hear the score." They listened carefully and commented on their performance. When the comments were all heard, exhausted but happy, Karen's friends went home.

Most people interpret this passage in terms of an evening of cards but it can be interpreted as about a rehearsal of a woodwind ensemble. Another passage is usually seen as about a convict planning his escape from prison, however it is possible to see it in terms of a wrestler hoping to break the hold of an opponent. These passages were read by a group of physical education students and a group of music students. Scores on a multiple-choice test and theme-revealing disambiguations and intrusions in free recall indicated that the interpretation given to passages bore the expected strong relationship to the subject's background. An example of an intrusion showing a card theme was, "Mike sees that Pat's hand has a lot of hearts." One showing a music theme was, "As usual they couldn't decide on the piece of music to play."

Of special significance to the discussion in this section were responses on a debriefing questionnaire. Subjects were asked whether they became aware of another possible interpretation of either passage. The interesting fact is that 62% reported that another interpretation never occurred to them, while an additional 20% said they became aware of an alternative interpretation during the multiple-choice test or when responding to the debriefing questionnaire. Less than 20% said they were aware of a second interpretation while reading a passage. Many people would not wish to place too much stock in retrospective reports. Still, these are the results that would be expected on the basis of top-down, schema-based processing.

Gordon Bower (cf. 1977) and his coworkers at Stanford have completed several studies which parallel those done in my laboratory. One study involved stories about characters who visit the doctor. An examination is completed and the doctor smiles and says, "Well, it seems my expectations have been confirmed." The base story was, in Bower's words, "a sort of neutral Rorshach card onto which subjects could project their own meanings" (1977, p. 8). The introduction to one version of the story describes the character as worried about whether she is pregnant. Here subjects tended to recall the doctor's remark as, "Your fears have been confirmed" or simply, "You're pregnant." An alternate introduction described the main character as a wrestler worried about being underweight. Subjects who read this version remembered that the doctor told the character he was gaining weight.

In another study, Bower and his associates used a story about a series of mishaps that happen when a TV commercial involving water skiing is filmed. Alternate introductions were written to cause the reader to identify with either Harry, the boatdriver, or Rich, the water skier. On a recognition test subjects tended to rate as explicitly part of the text statements formulated from the perspective of the character with whom they were led to identify. For instance, more subjects given the water skier than the boatdriver introduction identified, "The handle was torn from Rich's grasp as the boat unexpectedly jumped ahead," as a proposition from the text. The reverse was true of the parallel formulation of the same episode written from the boatdriver's perspective: "Rich slipped and lost control and the handle went skipping across the water."

The general point illustrated by these experiments is that the meaning of a text arises in an interaction between the characteristics of the message and the reader's existing knowledge and analysis of context. Ambiguous passages are useful for making transparent the role of world knowledge and context. However, there is every reason to suppose that they are equally important when comprehending material which would be said to be "unambiguous." A message has an unambiguous meaning just in case there is consensus in a linguistic community about the schemata that normally will subsume it. The role of knowledge of the world is merely less obvious to the psychologist doing prose memory research in these cases, for the author, reader, and the judges who score the protocols employ complementary schemata and thus give essentially the same interpretation to the material.

Schemata and the Significance of Text Elements

Since Binet and Henri (1894; Thieman & Brewer, in press) worked with French school children at the end of the nineteenth century, it has been known that people are more likely to learn and remember the important than the unimportant elements of a prose passage. No doubt authors provide linguistic cues to the important points in a text; however, I shall argue that importance is largely a derivative of the schemata the reader imposes on the text.

The schema brought to bear on a text will contain embedded subschemata which generally can be conceived to form a hierarchy. The position of a subschema in the hierarchy is one index of its importance. Significant text information instantiates high-order slots in the structure. The schema could be said to "give" such information its importance. It follows that the importance of a text element would vary if readers were caused to invoke schemata in which the text element played a greater or lesser role. This hypothesis has been investigated in two lines of research in my laboratory.

Anderson, Spiro, and Anderson (1977) wrote two passages--one about dining at a fancy restaurant, the other a closely comparable story about shopping at a supermarket. The same eighteen items of food, attributed to the same characters, were mentioned in the same order in the two stories. Subjects read one of the stories and then, after an interval, attempted recall.

The first prediction was that the food items would be better learned and recalled when presented in the restaurant narrative. The reasoning

was that a dining-at-a-fancy restaurant schema contains a more finely articulated structure. That is, certain categories of food will be ordered and served. And, there are constraints on the items that can fit into these categories; hot dogs will not be the main course nor Koolaid the beverage. Just about any food or beverage fits a supermarket schema. This prediction was confirmed in two experiments.

The second experiment involved food categories determined on the basis of a norming study to have a high or a low probability of being in an individual's restaurant schema. An entrée and a drink during the meal are examples, respectively, of the low and high categories. An entrée is an essential element. No fine meal would be complete without one. A drink during dinner is a less central, perhaps optional element. Subjects who read the restaurant story recalled substantially more of the foods and beverages from three high probability categories than subjects who read the supermarket story. In contrast there was no difference between the two passages on items from three low probability categories. This shows that the restaurant narrative did not indiscriminately facilitate performance as would be expected if it were overall more interesting, coherent or memorable. Instead, as predicted, there was selective enhancement of items from just those categories that have special importance in a restaurant schema.

The next prediction was that subjects would more accurately ascribe foods to characters when given the restaurant story. Who gets what food has significance within a restaurant schema whereas it matters not in a supermarket who throws the brussel sprouts into the shopping cart. In

both experiments the conditional probability of attributing a food item to the correct character given that the item had been recalled was higher among subjects who received the restaurant than the supermarket story.

Finally, it was predicted that order of recall of food items would correspond more closely to order of mention for subjects who read the restaurant passage. There is not, or need not be, a prescribed sequence for selecting foods in a grocery store, but at a fine restaurant it would be peculiar to have a strawberry parfait before the escargot. In the first experiment, the average correlation between recall order and order of mention was significantly higher for the group that received the restaurant than the supermarket narrative. The trend was in the same direction but not significant in the second experiment, perhaps because recall was attempted shortly after reading. There had been an hour and a half interval before recall in the first study. Maybe surface order information is available shortly after reading and this makes the generic order information inherent in a schema superfluous.

The experiments just described used the trick of weaving the same information into two different narratives in order to get readers to assimilate that information to two different schemata. The device in a second, parallel line of research was to ask subjects to read a narrative from alternative points of view which, presumably, caused them to invoke different schemata. Pichert and Anderson (1977) asked subjects to read stories from one of two perspectives or no directed perspective. One of the stories ostensibly was about what two boys do when skipping school. They go to one of the boy's homes since his mother is never home on

Thursdays. It is a well-to-do family with a luxuriously appointed home. It has a number of attractive features such as spacious grounds, a tall hedge that hides the house from the road, and a new stone fireplace. However, it also has some defects including a musty basement and a leaky roof. The family has many valuable possessions--silverware, a coin collection, a color TV set. Readers were asked to approach the story from the viewpoint of a burglar or a prospective homebuyer. Obviously a coin collection is important to a burglar but unimportant to a homebuyer. The opposite is true of a musty basement or a leaking roof. In a preliminary experiment the average intercorrelation of rated idea unit importance across three perspectives on each of two stories was determined to be quite low, which is in itself evidence that schemata determine the significance of text elements.

The next experiment manipulated perspective to investigate the effects of schemata on text learning and recall. The previously obtained ratings of idea unit importance were strongly related to immediate recall and, independently, to delayed recall. This was true just of ratings obtained under the perspective the subject was directed to take, not other possible but nonoperative perspectives. Rating of importance under the operative perspective was a significant predictor of recall in five of six stepwise multiple regression analyses (one for each of three perspectives on each of two stories). It was the only significant predictor in four of these analyses.

The past few years have seen increasing refinement of the notion of importance in terms of theories of text structure (cf. Kintsch, 1974;

Meyer, 1975; Rumelhart, 1975; Mandler & Johnson, 1977). These are more properly regarded as theories of the structure of the schemata by which a linguistic community normally will subsume a message, as some theorists expressly acknowledge. But a text need not be read "normally." Depending on the reader's goal, task, or perspective he or she may override the conventions a linguistic community ordinarily uses to structure a text. When the schema changes, then, so will the importance of text elements.

Possible Effects of Schemata on Encoding and Retrieving Text Information

In this section I shall give a more detailed account of some of the mechanisms by which schemata may affect the processing of text information. The phenomenon that I will concentrate on explaining is the primacy of important text in recall illustrated in the preceding section.

Significant text elements might be better recalled because they are better learned. In other words, the effect might be attributable to a process at work when a passage is read. An attractive possibility is that the schema provide the device by which a reader allocates attention. Extra attention might be devoted to important text elements whereas insignificant elements might be skimmed or processed less deeply. A second possibility on the encoding side is that a schema provides "ideational scaffolding," to use Ausubel's (1963) apt term, for selected categories of text information. A schema will contain slots for important information, but may contain no slots, or only optional slots, for unimportant information. According to this view information gets encoded precisely because there is a niche for it in the structure. This is an interesting idea, but as

yet I have been unable to think of any implication of the ideational scaffolding hypothesis that might permit it to be distinguished from the regulation-of-attention notion.

The fact that people recall more important than unimportant text elements might be due to processes at work when information is retrieved and used, instead of, or in addition to, processes acting when the information was initially encoded. There are several possible retrieval mechanisms that fall out of a schema-theoretic orientation which might account for the primacy of important text information in recall.

The first can be called the "retrieval plan" hypothesis. The idea is that the schema provides the structure for searching memory. Consider for illustration the burglar perspective on the story about two boys playing hooky from school. The rememberer will possess the generic knowledge that burglars need to have a way of entering a premise; that they are interested in finding valuable, portable objects that can be fenced easily; that they are concerned to avoid detection; and that they aim to make clean getaways. Memory search is presumed to start with the generic concerns of a burglar. Generic concerns implicate selected categories of text information. For instance, the fact that all burglars need to enter the place to be robbed is assumed to provide a mental pathway or implicit cue for the specific proposition that the side door was kept unlocked. On the other hand, information in a text which may have been encoded but does not connect with the schema guiding memory search should be relatively inaccessible. For example, the passage about the boys playing hooky from school asserts that the house has new stone siding. Presumably there are no pointers in

a burglary schema to information of this type and, thus, this information is unlikely to be retrieved even if it were stored.

We have termed another possible retrieval explanation the "output editing" hypothesis. The assumption is that the schema contains within itself an index of importance. The rememberer establishes a response criterion based jointly on this index, motivation, and demand characteristics. There are several variants on how output editing might work. In crudest form, the subject simply might not write down information that occurred to him or her because it falls below the response criterion.

I will consider, finally, the possibility that people may remember more important than unimportant information because of a process of "inferential reconstruction" (Spiro, 1977). There may be information missing from memory either because the information was not stored, or because it has been forgotten. The conceptual machinery of the schema and the information that can be recalled may permit the rememberer to fill gaps by inference. Anderson, Spiro, and Anderson (1977) have illustrated how the process might work as follows. Suppose that a person is trying to recall a story about a meal at a fine restaurant (see the preceding section). The beverage served with the meal cannot be recalled, but since there is a slot in a restaurant schema for such an item, the rememberer is led to try to reconstruct one. If the information that beef was served for the main course can be recalled, then red wine may be generated as a candidate beverage. There are a couple of possible scenarious at this point. Red wine might be produced simply as a plausible guess. A good guess and an element actually remembered often will be indistinguishable to a judge,

particularly one applying lenient, gist scoring criteria. Or, it might be that once a candidate element, such as red wine, has been produced it is checked against an otherwise inaccessible memory trace. To say this another way, the process might be one of generation followed by recognition and verification (Kintsch, 1974). In any event, the foregoing gives an account of the primacy of important text information, for the schema is more likely to contain the concepts for reconstructing important than unimportant elements.

Evidence for Encoding and Retrieval Benefits

We have completed several experiments to determine whether schemata have independent effects on the encoding and retrieval of text information and, if so, to begin to pin down the specific mechanisms that are responsible. My student, Jim Pichert, and I (Anderson & Pichert, 1977) asked undergraduates to read the story about two boys playing hooky from school from the perspective of either a burglar or a homebuyer. The story was recalled once from the same perspective from which it had been read. Then everyone recalled the story for a second time. Half the subjects did so again from the same perspective. The other half changed perspectives. Based on previously obtained ratings, a cluster of information important to a burglar but unimportant to a homebuyer (e.g., a collection of rare coins), and another cluster important to a homebuyer but unimportant to a burglar (e.g., a fireplace), were identified. As expected, subjects produced on the second recall a significant amount of new information--that is, information that had not been recalled the first time--which was important in

the light of the new perspective, but which was unimportant in terms of the perspective operative when the passage was read and recalled the first time. There does not appear to be any way to explain this finding solely in terms of encoding mechanisms. Thus, it seems to be rather strong evidence for a retrieval mechanism independent of encoding.

In the preceding section three explanations within schema theory for an influence on retrieval were discussed. To review briefly, the first is the retrieval plan hypothesis: a new schema will furnish implicit cues for different types of text information. The second is the output editing hypothesis: when the schema changes different types of information are above a response criterion. The third is the inferential reconstruction hypothesis: a new schema will provide the concepts for infering different categories of important but unavailable information.

In a follow-up study, Pichert and I replicated the retrieval benefit identified in the experiment described above. We also collected subjects' introspective descriptions of the processes of learning and remembering. Most subjects discussed strategies and tactics for remembering in a manner consistent with the retrieval plan hypothesis. A number said in so many words that reviewing the concerns of a burglar or homebuyer caused them to think of previously unrecalled information related to these concerns. For example, one subject said, "I was thinking . . . was there anything wrong with the house? And then I remembered the basement was damp." Another said, "I remembered [the color TV] in the second one, but not the first one. I was thinking about things to steal, things to take and steal . . ."

The self-report protocols generally gave little support to the output editing hypothesis. Most subjects insisted that they wrote down everything they could remember. John Surber, another student of mine, manipulated the incentive for recall. He reasoned that if the increment in recall in the perspective-shift group were due to output editing, then the increment would disappear under conditions of high incentive. What he actually found was a difference in favor of subjects who shifted perspective regardless of whether a 25¢ bonus was paid for each new idea. Thus, two strands of evidence weigh against an output editing interpretation of the results of this series of experiments. I do not wish to argue that people never suppress information available to them, only that this probably was not a major factor under the conditions that have prevailed in our research.

Spiro (1977) has obtained convincing evidence for reconstructive processes in memory for discourse. Subjects read a story about a couple engaged to be married. The man is strongly against having children. In one version of the story the woman is elated to find this out because she doesn't want children either. In the other version, she is horrified because a large family is important to her. Several minutes after reading the story subjects are told either that the couple did get married or that they broke up. Based on the assumption that people's common-sense psychology of interpersonal relations could be represented in terms of Heider's principle of structural balance, Spiro predicted the particular types of "reconciling errors" subjects would introduce into their recall protocols when the situation described to them was imbalanced. For instance, when the couple got married despite the serious disagreement about having

children, it was argued that subjects would modify the story to reconcile the incongruity by claiming, for instance, that "the problem was resolved when they found out that Margie couldn't have children anyway." The expected types of reconciling inferences appeared with increasing frequency over a retention interval of six weeks. Subjects were more confident their inferences had been part of the story than they were that propositions that had an explicit basis in the text had been present.

The perspective shift studies described earlier in this section all showed a retrieval benefit but, for a couple of reasons, none clearly established that schemata have an encoding influence as well. This was the purpose of another experiment completed by Jim Pichert and me. A story was recalled just once, from either the same perspective from which it was read or a different one. Both the perspective from which the story was read and the perspective from which it was recalled, which were orthogonal factors in the design employed, had a substantial effect on performance. Thus, both encoding and retrieval influences were demonstrated.

When asked how the assigned perspective affected the manner in which the story was read, most subjects described a process of directing attention to important elements. For example, one subject told to take the burglar perspective said, "I kept in mind all of the critical things a burglar would be looking for such as getting in and out, the items that it would be easy to move and take from the house itself." One assigned the homebuyer perspective reported, "I spent most of the time looking for items to be interested in when buying a house." A straightforward way to get converging evidence on the regulation-of-attention hypothesis would

be to time subjects on chunks of text material whose importance has been manipulated in some way. We haven't done experiments of this type yet.

In summary, in this section I have reviewed evidence that a schema operative when a passage is read affects encoding, possibly by directing attention to text elements that are significant in the light of the schema. Evidence was presented which shows that later the schema affects remembering, probably in part by providing the plan for searching memory. Schemata probably also provide the basis for inferential elaboration when a passage is read and inferential reconstruction when there are gaps or inconsistencies in memory.

Implications of Schema Theory for Education

Text information is interp eted, organized, and retrieved in terms of high-level schemata. It follows that the student who doesn't possess relevant schemata is going to have trouble learning and remembering the information encountered in stories and textbooks. Consider for illustration the description of an unfamiliar nation in a geography text (cf. Anderson, Spiro, & Anderson, 1977). The mature student will bring to bear an elaborate Nation schema which incorporates well-formed subschemata for assimilating information about the topography, climate, economy, culture, and political system. It is only a slight oversimplification to say that the task for the advanced student is simply to fill the slots in an already formed schema with the particular information in the text about the unfamiliar nation. The information will be readily acquired and, once acquired, easily retrieved when needed.

How about the young reader who, for the sake of the argument, will be assumed not to possess a refined Nation schema? In the worst case a description of an unfamiliar nation would be unintelligible to such a reader, like the Bransford and Johnson (1973) passages for mature readers when a schema-evoking context was not provided. More likely, the young reader will have a partly formed Nation schema sufficient for some level of understanding of the material, but which will not enable a representation of great depth or breadth.

Whether people possess the schemata appropriate for assimilating a text should be an important source of individual differences in reading comprehension. Smiley, Oakley, Worthen, Campione and Brown (1977) have obtained some evidence suggesting that this may be the case. Good and poor readers drawn from seventh-grade classes read one folktale and listened to another. Following each story, they were tested for comprehension and recall. Under both reading and listening conditions, good readers recalled a greater proportion of the stories and the likelihood of their recalling a particular element was an increasing function of the element's structural importance. Poor readers not only recalled less of the stories, but their recall was not as clearly related to variations in importance. Smiley et al. went on to show that it was necessary to test children as young as first grade before finding another group which showed as little sensitivity to gradations of importance as poor reading seventh graders (see also Brown & Smiley, 1977). On the other hand, Perfetti and Lesgold (in press) have summarized several studies which, by and large, have not revealed substantial differences among good and

poor readers in sensitivity to sentence structure or text structure.

Thus, based on evidence already available, it is too early to say whether variations in high level schemata, or facility in using these schemata, will turn out to be a consistent difference between good and poor readers. I hope only to have shown that this is a very reasonable place to look for differences. If differences are consistently found there will be implications for diagnosis, design of lesson materials, and approaches to teaching.

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